CIRM – Interim Economic Impact Review

Submitted to:
California Institute for Regenerative Medicine (CIRM)

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1. Executive Summary

The California Institute for Regenerative Medicine ("CIRM") was established by Proposition 71 in late 2004 and has begun operations to issue bonds and to use the proceeds from those bonds to make grants in support of stem cell research and infrastructure projects in California. The purpose of this report is to begin to assess the economic implications of this funding for California. It is important to note, of course, that these grants have only recently been approved and activities under these grants are only now beginning to go forward. Grants approved thus far are about 20 percent of the $3 billion in funding approved by the voters, and CIRM activities are ongoing and further funding activities are expected.[1] It is thus too early to expect to observe significant quantifiable health and economic benefits from CIRM's funding.

Investing State funds in stem cell related activities could have both economic and non-economic implications. On the economic side, the public investment of an anticipated $3 billion in stem cell research, at a net cost of approximately $6 billion including interest on the long-term debt, legitimately requires continuing reports on the returns on that investment. Assessing whether or not the CIRM investment ultimately produces financial and non-financial returns sufficient to justify the costs will require multi-faceted efforts over a long time period. One piece of such an assessment will necessarily be information about the grants provided by CIRM and their impacts on medical and economic activities that could produce economic benefits. While it is clearly too early in the course of CIRM's activities to make a broad assessment of their economic benefits, it is possible to begin to monitor and report on some aspects of CIRM's activities and their relationships to possible sources of economic benefits.

INITIAL LINKS TO ECONOMIC IMPACT

We provide a very preliminary look at CIRM's initial investment activities, and begin to report on links to their economic impact. Because of the point in the life cycle of CIRM at which this analysis is conducted, the information on which we draw is limited and includes CIRM data, previous analyses, self-reported information by a number of institutions, universities, and private sector firms in California, and other information available from public sources. We encourage further, more detailed, research over time, which would be able to produce more detailed and complete analyses. In addition, establishing mechanisms to monitor certain activities, which we discuss in later sections, will make subsequent analyses more available.

By encouraging new economic activities, such as new research endeavors and the construction of new research facilities, CIRM activities will lead to the creation of new jobs in California and increases in the purchases of supplies and other services. These activities would create economic benefits for Californians. They may also produce benefits for the State finances from sources such as increased tax receipts. To date there have been 229 CIRM grants committed, for over $614 million in total funding, distributed to 27 institutions.[2] Our initial findings suggest the following preliminary evidence that is consistent with benefits since the founding of CIRM in 2004:

At least 45 senior researcher leaders from out of state were recruited to join California institutions, as well as many other young scholars and researchers. While the ratio will vary from grant to grant, initial applications demonstrate that each senior researcher will include approximately 10 additional researchers on the team, attracting millions of dollars in additional research grant

[1] As of June 2008, CIRM has disbursed $554 million, which is approximately 18 percent of the $3 billion approved by California voters. See "Approved CIRM Grants as of June 2008", California Institute for Regenerative Medicine dated June 2008.

[2] Ibid.

contracts. This could result to up to 450 additional researchers in California, but detailed follow-on analysis should be done in a subsequent report.[3],[4]

Estimated matching funds to date have averaged over 226 percent of the CIRM-provided amount for the major facilities, shared labs, and banks and cores grants, with the largest portion of the matching funds from the major facilities program[5]. This is well over the minimum of 20 percent matching funds required from recipients in the CIRM application[6] and greater than the 15 percent matching funds modeled in the preliminary 2003 economic analysis.[7]

Philanthropic giving for stem cell research has been substantial since January 2005.[8] In total, well over $900 million dollars has been donated by various organizations and individuals to California universities and institutes (and/or committed by institutions) to fund direct research, construction, and improvement of facilities, and recruitment related to stem cells.[9] These amounts were driven by the establishment of CIRM and represent the CIRM matching funds.

Some stem-cell related companies appear to have increased activities in California. For example, Stem Cell Sciences is expanding into California from the UK, and companies like Invitrogen and Novocell (formerly CyThera) have hired new scientists from within and outside the U.S.[10] Other companies, such as Jackson Labs, have committed to major relocations or large-scale expansions in California. As an example, Jackson Labs is in the process of developing and expanding a new California research facility near Sacramento that will ultimately be more than 200,000 sq ft.[11]

CIRM has established international collaborations, beginning with Canada and the Australian state of Victoria. These are consistent with California being increasingly recognized as a world leader in the field of stem cell research with its efforts to accelerate and drive discoveries to clinics and patients. California's research expenditures will predictably gain economic leverage from international collaborations, such as the $100 million in Canadian dollars ($97.7 million in US Dollars) pledged by Canada for collaborations on cancer stem cell research. [12] These specific influences on the success and speed of the development of stem cell therapies were not originally anticipated. The indirect economic impacts of these international collaborations should be analyzed in another report.

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[3] Data provided to CIRM by research applications

[4] "Senior Researchers and Other Researchers Ratio", CIRM.

[5] See Figure 13 in Addendum 1 to this report.

[6] CIRM total grant amount is amount requested by applicant. This may include errors in calculations or inclusion of items that were subsequently removed from the application by the Facilities Working Group on a technical revision of a curable deficiency. Total amount includes requests for Shared Lab and Course costs as requested by the applicant. Some applicants were granted a shared lab without the accompanying course. Source: CIRM.

[7] "Analysis of the Financial Impact on the California State Budget of the Proposed California Institute of Regenerative Medicine" Baker, Laurence, and Deal, Bruce, dated 10/27/2003

[8] "Reported Stem Cell Activities in California: 2005-2007,"CIRM, November 2007; Migration of Stem Cell Researchers to California, CIRM 2006 Annual Report, p.53; Novocell is headquartered in San Diego, CA and merged with CyThera and Bresagen in 2004, http://www.novocell.com/about/ as accessed on 12/29/07.

[9] See Figure 13 in Addendum 1 to this report.

[10] "Migration of Stem Cell Researchers to California since January 2005", CIRM.

[11] Email from Chuck Hewett, Vice President and Chief Operating Officer, The Jackson Laboratory, dated 7/29/2008.

[12] "Minister Clement, Governor Schwarzenegger Join Forces to Fight Cancer through Cancer Stem Cell Research", CIRM Press Release dated 6/18/2008. To calculate the grant amount in US Dollars, the 7/30/2008 exchange rate of 1 Canadian Dollar = 0.977 US Dollars was used.

All told, the information available to date suggests that California is already starting to see new economic activity resulting from CIRM and that there is significant potential for additional future economic benefits. More careful analysis that could better assess the extent to which these are incremental increases in activity for California would provide valuable information. Further analysis could also more precisely consider the potential for benefits of different types, such as benefits to the health of Californians and for the State finances.

2. The Current Status of CIRM

1. OVERVIEW OF CIRM FUNDING

Passed by California voters in November of 2004, Proposition 71 created a new infrastructure for funding stem cell research in California. The California Institute for Regenerative Medicine ("CIRM") was established by the Proposition with the mission of using bond-generated funding to support stem cell related research and infrastructure projects. These activities are now underway. In October 2007, CIRM, under the direction and control of the California State Treasurer, issued $250 million of general obligation bonds: "The California Stem Cell Research & Cures Bonds". Of the proceeds, $48 million were used to repay bond anticipation notes and bridge loans from private sources that were used to support CIRM operations and initial grant-making in the start-up phases of their activities. The remainder of the proceeds will fund various grants.[13] To date, CIRM has approved grants totaling over $614 million to 27 institutions under nine initiatives:[14]

- *Training Grants Initiative*: to provide $37.5 million of funding for the training of 169 pre-doctoral, post-doctoral, and clinical scholars.[15]

- *Scientific Excellence through Exploration and Development ("SEED") Grants Initiative*: to bring in new researchers and new ideas in the field of human embryonic research. This initiative provides 73 grants totaling $45.3 million over a two-year period.[16]

- *Comprehensive Research ("Comp") Grants Initiative*: to fund the mature ongoing research of established scientists in the field of human embryonic stem cells ("hESC"). Comp Grants in the amount of $72 million will be provided to 28 projects over a four-year period.[17]

- *Shared Research Laboratory and Stem Cell Techniques Course Grants Initiative ("Shared Research Labs Grants")*: to finance the construction, equipment, and three-year operating expenses of shared laboratory space dedicated to hESC research as well as training of scholars and technical staff. The total amount of Shared Research Laboratory Grants approved to date is $50.5 million which will be distributed to 17 institutions.[18]

- *Major Facilities and Research Equipment Grants Initiative*: to fund the construction of new facilities and the purchase of new equipment needed for the research and development of therapies based on hESC and other stem cells. To date, $271 million has been awarded to 12 institutions.[19]

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[13] "Treasurer Lockyer Announces Results of First Stem Cell Research Bond Sale; Individuals Buy $102.8 Million of $250 Million", CIRM Press Release dated 10/4/2007.

[14] "Approved CIRM Grants as of June 2008", CIRM document dated June 2008.

[15] "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007; "Stem Cell Institute Awards First Scientific Grants", CIRM Press Release dated 4/10/2006.

[16] "$45 Million Headed For Stem Cell Research in California", CIRM press release dated 2/16/2007.

[17] "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007.

[18] "First Stem Cell Research Facilities Grants Approved", CIRM press release dated 6/5/2007.

[19] "CIRM Solicits Major Facilities Grant Applications", CIRM press release dated 8/24/2007; Agenda Item #10, 12/12/2007 ICOC Meeting and per discussion with CIRM.

- *New Faculty Awards Initiative I & II*: Provides $113.4 million for salaries and research funding (up to five years) for promising scientists in the early stages of their careers.[20]

- *New Cell Lines Grants Initiatives:* to support the derivation and propagation of new lines of pluripotent human stem cells with important research and clinical application for understanding, diagnosing and treating serious injury and disease. This initiative provides $23 million in funding for 16 grants.[21]

- *Disease Team Planning Awards Initiative***:** to support multi-disciplinary teams of scientists in pursuit of therapies for specific diseases. The Disease Team Planning grants provide relatively modest grants to scientists who will use the funds to assemble multi-disciplinary teams that will help prepare proposals that can respond to an upcoming request for proposals for major grants for translational research that could lead to human clinical trials within 48 months. Disease Team Planning awarded $1.1 million for 22 grants.[22]

Figure 1 provides further information about the amounts of funds approved through June 2008. In addition to these approved funding levels, the Bank & Cores program for facilities and equipment spending is currently pending future approval with $35 million in additional funding.

The purpose of this report is to begin to assess the economic implications of this funding for California. It is important to note, of course, that these grants have only recently been approved and activities under these grants are only now beginning to go forward. It is thus relatively early to expect to observe obvious and easily quantifiable economic effects from CIRM funding activities to date.

CIRM activities are ongoing, and additional grants and funding activities are anticipated. Grants approved thus far are less than 20 percent of the $3 billion in funding approved by the voters. Any indication that can be obtained about the effects of CIRM funding at this point will clearly be an incomplete assessment of the effects of CIRM activity that might be realized as the extent of CIRM funding grows over time. For example, in addition to the above eight initiatives, CIRM has began the application process for other initiatives such as Tools & Technologies Awards, CIRM Bridges to Stem Cell Research Awards, CIRM Research Training Program II, Translational I Research Awards, Disease Team Grants, and other program commitments for which the Institute expects to disburse up to $340 million.[23]

Information about expected funding for these initiatives is highlighted in Figure 1. Beyond these initiatives, we understand that there are other programs being considered by CIRM, including a possible loan program.[24]

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[20] "CIRM Announces New Faculty Awards to Fund Next Generation of Stem Cell Scientists", CIRM press release dated 12/12/2007. "CIRM Announces New Faculty II Awards to Support Early Careers of Promising Stem Cell Researchers", CIRM press release dated 8/13/2008.

[21] "$24 Million in New Stem Cell Research Funding Awarded to 25 California Institutions", CIRM press release dated 6/27/2008.

[22] Ibid.

[23] President's Report, Agenda Item #7 - CIRM's governing board (ICOC) meeting 6/26/2008 and 6/27/2008.

[24] An additional alternative to grants which CIRM is currently examining is a loan program targeting for-profit entities. The goals of such a program would be: 1) to fund the initial stages of developing discoveries into products before venture capital and/or biotech capital is available, and 2) to generate additional financing for CIRM through loan payments which could be used for additional grants and loans. Proposed ICOC Biotech Loan Program Task Force, Agenda Item #11B - Updated, 10/3/2007 ICOC Meeting.

Figure 1: Summary of Grants Authorized To Date[25]

Grant Initiative	Grants Approved to Date: Count	Grants Approved to Date: Amount (in $ million)
1. Training Grants [A]	16	$37.5
2. Scientific Excellence through Exploration and Development ("SEED") Grants [B]	73	45.3
3. Comprehensive Research ("Comp") Grants [C]	28	72.0
4. Shared Research Laboratory Grants [D]	17	50.5
5. New Faculty Awards Grants [E]	22	54.4
6. Major Facilities and Research Equipment Grants [F]	12	271
7. Disease Team Planning Awards [G]	22	1.1
8. New Cell Lines Awards [H]	16	23.2
9. New Faculty Award Grants [I]	23	59.0
Total Grants	**229**	**614.1**

We focus here on activities that can be observed at this point in time. Going forward, further effects of CIRM activities will depend on the specific characteristics of funding undertaking by CIRM, the ways in which funding programs develop over time, and

[25] Notes and sources to Figure 1:

A. "$45 Million Headed For Stem Cell Research in California", CIRM press release dated 2/ 16/ 2007; "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/ 16/ 2007; "First Stem Cell Research Facilities Grants Approved", CIRM press release dated 6/ 5/ 2007; "CIRM Announces New Faculty Awards to Fund Next Generation of Stem Cell Scientists", CIRM press release dated 12/ 12/ 2007. Note that the figures were derived by reconciling the data from the above press releases.

B. "$45 Million Headed For Stem Cell Research in California", CIRM press release dated 2/ 16/ 2007; "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/ 16/ 2007; ICOC Meeting Transcript dated 10/ 3/ 2007.

C. "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/ 16/ 2007 and ICOC Meeting Transcript dated 10/ 3/ 2007.

D. "First Stem Cell Research Facilities Grants Approved", CIRM press release dated 6/ 5/ 2007.

E. "ICOC Approves New Request for Applications for 14 New Faculty Awards", CIRM press release dated 1/ 17/ 08.[For second reference to New Faculty Awards II]

F. F: "California Stem Cell Agency, Donors and 12 California Institutions Commit $1.1 Billion to Increase the Capacity for Stem Cell Research in California", CIRM press release dated 5/ 07/ 2008.

G. "$24 Million in New Stem Cell Research Funding Awarded to 25 California Institutions", CIRM press release dated 6/ 27/ 2008.

H. "$24 Million in New Stem Cell Research Funding Awarded to 25 California Institutions", CIRM press release dated 6/ 27/ 2008.

I. "CIRM Announces New Faculty II Awards to Support Early Careers of Promising Stem Cell Researchers", CIRM press release dated 8/ 13/ 2008.

possibly other factors. CIRM appears to have made substantial progress in beginning operations, but there remain a number of uncertainties that may impact its economic results, as suggested by recent events.

At the time Proposition 71 was passed in late 2004, the initial expectation was that CIRM would begin funding in 2005. As has been widely reported in the press, this schedule has been modified due to numerous legal challenges. In 2005, two lawsuits were filed challenging the constitutionality of the California Stem Cell Research and Cures Act (Proposition 71). These proceedings prevented CIRM from issuing general obligation bonds in 2005. In April 2006, the Alameda County Superior Court upheld the constitutionality of the Act.[26] In June 2006, this decision was appealed in the State Court of Appeal. In February 2007, the State Court of Appeal also upheld the constitutionality of Proposition 71.[27] Plaintiffs attempted to appeal the Court of Appeal decision in the California Supreme Court but in May 2007, the California Supreme Court denied plaintiffs' petitions, thus resolving the matter and allowing CIRM to begin the process of issuing bonds.[28] In the interim period, CIRM borrowed $150 million from the State and raised $45 million through bond anticipation notes issued by the State and purchased by foundations and private parties.[29] These challenges introduced significant delays, but CIRM activities have moved forward. Figure 2 below illustrates the impact of the delay on the estimated commitments to date. In addition to these now-resolved legal challenges to the very existence of CIRM, there have been, and likely will continue to be other important legislative discussions related to CIRM activities that may influence the impacts it will have in the future.[30] Including projected donor and institutional matching funds, the total CIRM-related spending during the first 5 years was originally projected to be $1.55 billion in CIRM funds and $310 million in matching funds, for a total of $1.86 billion. Current actual spending is projected to be only $930 million in CIRM funds but totaling $1.83 billion including $900 million in donor and matching funds.

[26] "California Institute for Regenerative Medicine, Annual Report 2006", pages 48-49.

[27] "California Stem Cell Project Prevails", CIRM Press Release dated 2/27/2007.

[28] "Litigation Against California Stem Cell Project Ends", CIRM Press Release dated 5/16/2007.

[29] "California Stem Cell Project Prevails", CIRM Press Release dated 2/27/2007.

[30] For example, the Senate Health Committee and the Assembly Health Committee hearings to review the implementation of Proposition 71 on March 9, 2005, Assembly Budget Subcommittee on Education hearings to consider the establishment of the CIRM and the ICOC on May 4, 2005, and Assembly Select Committee on Biotechnology hearings to examine the life sciences industry in California on January 12, 2006. "California Institute for Regenerative Medicine, Annual Report 2006," page 30.

Figure 2: CIRM Institute Commitments - Projected vs. Current Estimates ($ Millions)[31]

	Year 1 Projected	Year 2 Projected	Year 3 Projected	Year 4 Projected	Year 5 Projected	5-Year Total Projected
Project Commitments - Projected (2003) [A]						
Facilities	$ 20	$ 100	$ 100	$ 80	$ -	$ 300
Research	$ 150	$ 250	$ 250	$ 300	$ 300	$ 1,250
Total Committed Funds	**$ 170**	**$ 350**	**$ 350**	**$ 380**	**$ 300**	**$ 1,550**

	2005	2006	2007 Current Estimate	2008 Current Estimate	2009 Current Estimate	5-Year Total Current Estimate
Project Commitments - Current Estimate (2008) [B]						
Facilities	$ -	$ -	$ 14	$ 227	$ 35	$ 276
Research (including equipment)	$ 38	$ -	$ 208	$ 132	$ 276	$ 654
Total Committed Funds	**$ 38**	**$ -**	**$ 222**	**$ 359**	**$ 311**	**$ 930**

	Five Year Total Estimate	2007-2011
Other Donor and Institutional Matching Funds (2008) [C]		
Total Facilities Spending		
Major Facilities Grant		$ 561
Shared Labs Grant - Facilities Only		$ 4
Bank & Cores Grant		$ 7
Other Capital Costs associated with Spending on New Faculty Lab Research		$ 150
Lab Research Spending Associated with New Facilities		$ 179
Total Matching Funds		**$ 901**
TOTAL COMMITTED FUNDS - CURRENT ESTIMATE		**$ 1,830**

Sources and Notes:

A. "Analysis of the Financial Impact on the California State Budget of the Proposed California Institute of Regenerative Medicine," Baker, Laurence and Deal, Bruce, October 27, 2003, page 7.

B. CIRM press releases and data provded by CIRM.

C. See Figure 12 in Addendum 1 to this Report.

[31] Sources cited in Figure 2:

Sources and Notes:

A. "Analysis of the Financial Impact on the California State Budget of the Proposed California Institute of Regenerative Medicine," Baker, Laurence and Deal, Bruce, October 27, 2003, page 7.

B. CIRM press releases and data provded by CIRM.

C. See Figure 12 in Addendum 1 to this Report.

3. CIRM and the Question of Economic Benefits

1. INVESTMENT IN PUBLIC POLICY INITIATIVES AND MEASUREMENT OF ECONOMIC BENEFITS

As was identified very early on in the campaign to approve CIRM, the concept of investing State funds in stem cell related activities could have both economic and non-economic implications. On the economic side, the public investment of an anticipated $3 billion in stem cell research, at a net cost of approximately $6 billion including interest on the long-term debt, should be carefully analyzed to determine the returns on that investment. While state government investments are not identical to private-sector investment, the question of what economic benefits arise from spending state resources is very reasonable and deserves careful thought.

A number of previous reports have considered the impact that state stem cell funding programs can have on the well-being of society generally and on other particular entities like state governments. We produced two previous reports in the context of the Proposition 71 campaign, in which we considered economic aspects of the proposition, particularly as they relate to the State finances. Those reports highlighted the potential for economic effects from tax generation, increased business and research activity, improvements in health, and receipts from intellectual property ownership.[32] They also noted that while some benefits could begin immediately, others could only be realized over much longer time horizons. For example, tax receipts were modeled to commence shortly after funding under the proposition began, while improvements in health were modeled as becoming possible in as few as five or as many as 15 years, and receipts from intellectual property only beginning in the latter half of year 14. We have also been involved in subsequent analyses that have also considered aspects of economic and health benefits of stem cell research.[33] Others have also studied these issues, including other state governments interested in stem cell research,[34] and other analysts interested in particular topics such as the issues of royalties from intellectual property.

Assessing whether or not the CIRM investment ultimately produces financial and non-financial returns sufficient to justify the costs will require multi-faceted efforts over a long time period. One piece of such an assessment will necessarily be information about the grants provided by CIRM and their impacts on medical and economic activities that could produce economic benefits. While it is clearly too early in the course of CIRM's activities to make a broad assessment of their economic benefits, it is possible to begin to monitor and report on some aspects of CIRM's activities and their relationships to possible sources of economic benefits.

Our purpose in this report is to provide a very preliminary look at CIRM's initial investment activities, and begin to report on links to economic activities. Because of the point in the life cycle of CIRM at which this is conducted, and because of the limited time available for producing this report, the information on which we draw is limited and includes previous analyses, self-reported

[32] "Economic Impact Analysis: Proposition 71 California Stem Cell Research and Cures Initiative," Baker, Laurence, and Deal, Bruce, September 14, 2004; "Analysis of the Financial Impact on the California State Budget of the Proposed California Institute for. Regenerative Medicine," Baker, Laurence and Deal, Bruce, October 27, 2003.

[33] "Proposition 71 and the Creation of a California Institute for Regenerative Medicine: Assessing the Return on this Investment", Longaker, Michael T., Baker, Laurence C., and Greely, Henry T., Nature Biotechnology. 25:513-21, May 1, 2007; and Baker, Laurence C., Deal, Bruce., Some Economic Implications of State Stem Cell Funding Programs. in *States and Stem Cells: A Symposium on the Policy and Economic Implications of State-Funded Stem Cell Research* ed. AD Levine, Princeton University Policy Research Institute for the Region, Princeton, NJ, (2006) 51-74.

[34] "The Missouri Stem Cell Research and Cures Initiative: An Economic and Health Care Analysis", Haslag, Joseph H., and Long, Brian K.., August 2006.; "The Economic Benefits of the New Jersey Stem Cell Research Initiative," Seneca, Joseph J., Irving, Will, Edward J. Bloustein School of Planning and Public Policy Rutgers, The State University of New Jersey, September 2005; "The Economic Development Potential of Stem Cell Research in Texas," Weinstein, Bernard L., Clower, Terry L., March 2007; "A Scientific, Policy and Economic Analysis: New York and Stem Cell Research," Barba, James J., et al., January 2006.

information by a number of institutions, universities and private-sector firms in California, and other information available from public sources. We encourage further, more detailed, research over time, which would be able to produce more detailed and complete analyses. In addition, establishing mechanisms to monitor activities, which we discuss in later sections, will make subsequent analyses more available.

2. A FRAMEWORK FOR ASSESSING INVESTMENTS

A standard way of assessing the value of an investment is by the return the investor obtains from it. If one thinks of the State of California as eventually investing $6 billion, including interest payments, in stem cell research then one might wish to make a calculation of the return on this investment. It is perhaps clearest if these questions are framed initially in terms of the well-being – economists would say utility – of society. Here, the question is whether the State of California, and ultimately the citizens of California who will have to pay the taxes to repay the bonds, reap sufficient benefits in the form of improved well-being to justify the investment. In the absence of this investment, they could perhaps have retained this tax money for themselves and either spent it on something else or saved it. Or, under alternate government policies, the State government might have collected this tax money and used it for some other purpose. In either case, the alternate uses could have produced improvements in well-being. The question is ultimately whether the well-being increases produced by stem cell research are as large as or larger than those that would have been realized under alternate scenarios.

To start to provide for such an assessment, it will be important to begin to track the benefits received. We focus our efforts on benefits from encouragement of new economic activity, including new public and private research and business ventures, as this is the most plausible source of benefits that could begin to be realized at this early point in CIRM's existence. We also discuss the potential for benefits from improvements in health and the potential for intellectual property royalty revenue for the State; though, it is too early in the course of this new endeavor to expect identifiable returns from these sources.

One of the challenges that will ultimately face anyone wishing to assess the returns on this investment is the quantification of benefits in monetary terms. This can be challenging, particularly when the benefits may include things such as the improvement a patient experiences in his or her health. There are analytic approaches that have been developed and applied in many health economic analyses and that may ultimately prove valuable in this situation. We mention these in appropriate places, but we do not attempt here to undertake analysis at this level.

We take as our frame of reference the benefits and costs from the perspective of citizens of California. In some discussions, the alternate reference frame of the State finances has been used, in which analyses focus on the question of costs and benefits from the standpoint of the State finances only. In our previous report, for example, we provided estimates of health benefits for both the State finances and the citizens of California more broadly. Doing an analysis only focused on the State finances may be sensible, if one were only concerned with the monetary impact on the State finances, but would exclude some important sources of benefits that might come to California's citizens. If one only considers the State finances, then health benefits for Californians only create benefits to the extent that they do things that are economically tangible to the State, such as reducing net spending on Medi-Cal or other state health programs or improving the ability of people to work so that tax receipts go up and disability program payments go down. We believe CIRM should be considered with the broader set of benefits for the citizens of California in mind.

3. ECONOMIC IMPACT OVER TIME

Another challenge for the economic evaluation of CIRM's impact is the fact that both costs and benefits occur over time. If CIRM is successful in spurring innovation in therapies, these benefits could be realized for decades to come. Economists and others

frequently observe that money has "time value," which is to say that a dollar held in the hand today is worth more to a person than is the promise of a dollar to be given to them after, say, 10 years. By extension of this principle, spending a dollar today is more costly, from the standpoint of a person today, than promising to spend a dollar in ten years. In analyses of programs like CIRM, one must therefore "discount" in order to accurately value the costs and benefits of a program that accumulate over time.

The traditional approach is to value costs and benefits in terms of dollars held at the time the analysis is being conducted (often referred to as "present value"). In other words, value everything in the equivalent of 2008 dollars. In order to discount, one assigns a rate at which the value of a dollar will decline with time. One might use the assumption, for example, that a dollar declines in value going forward at a rate of 5 percent per year. A dollar received one year from now would have the same value as 95 cents held today. In this way, one can look at the future spending envisioned under CIRM, essentially the amounts to be repaid on the bonds to be issued and the time at which those payments are expected to be made, incorporate discounting, and come up with the present-day cost of that investment. One could also value the benefits obtained and use discounting to account for the fact that some of them, if they are realized, would only be realized many years in the future, creating measures of the benefits in present-day dollars. The comparison between the present value costs and the present value benefits would then better capture the different times at which costs and benefits are realized.

When describing and tracking the costs and benefits of policy changes it is important to be clear about whether discounted or future values are being used. As an example, in some previous work we did, one scenario we considered suggested that proposition 71 could end up costing Californians about $5.3 billion over time in total spending, i.e. in future value terms. But, since many of those costs would occur far in the future, after discounting those future costs would be equivalent to incurring a cost of about $2.1 billion today.[35] Similarly, in one set of hypothetical scenarios the State finances received savings from reduced health care costs and other categories of $6.4 billion over time. Many of these occur far in the future as well, so on a discounted basis this would be similar to receiving a benefit of $2.2 billion today. Comparing the discounted costs and benefits provides an opportunity for comparisons with less of the ambiguity that can arise when comparing costs and benefits that are realized at different times, in some cases many years down the road. However, there are circumstances where one may want to use future value terms – in fact, we understand that ballot measures are required to report future value and cost figures – and when both future value and discounted value cost and benefit figures are being discussed, one should always be sure that comparisons are made between appropriate figures.

In any case, information about any benefits from CIRM activities at this point is too limited to require sophisticated analyses incorporating discounting. Nonetheless, it will be very important for assessments going forward to carefully consider these issues.

[35] In this example, "today" refers to the date that the previous analysis was undertaken, in late 2004. We have not updated the original analysis to 2007/2008 dollars for the purposes of this report.

4. Economic Evaluation of CIRM Funding to Date

1. NEW ECONOMIC ACTIVITY ASSOCIATED WTIH INITIAL GRANTS

By encouraging new economic activity, such as new research endeavors and the construction of new research facilities, CIRM activities could lead to the creation of new jobs in California and increases in the purchases of supplies and other services. These activities would create economic benefits for Californians. They may also produce benefits for the State finances that could be realized from sources such as increased tax receipts.

An important consideration in the economic evaluation is the extent to which CIRM-related economic activity represents net new activity for California. Ultimately, only new activities that represent increases in the total amount of activity going on in California will create benefits for Californians. Only the attraction of net new faculty or incremental new research employment would benefit the State economically through taxes received and net new activity. There could be some net increase in activity even for faculty already residing in California if the overall level of activity and research spending and employment increased as a result of CIRM or current California researchers avoided job cuts and layoffs that would have occurred without CIRM funding. Similarly, the construction of new buildings is only of economic benefit if it added net new construction to the State.

CIRM funding could create new activity through a number of channels. First, the funding itself will presumably be used by the recipients to directly undertake activities that could produce economic benefits. Second, the presence of CIRM funds could be used by recipient institutions as "leverage" to encourage donations by others to support stem cell research; the donations could fund activities that generate economic benefits to the State. Third, the creation of a favorable funding climate for stem cell research in California could encourage other private economic activity, such as through the relocation of new businesses to California or the expansion of existing California businesses.

While the size of any such benefits should be studied, it is possible to establish some general expectations since previous analyses have considered the potential for benefits from these sources. Depending on the assumptions that one uses to support the calculations, the size of these benefits varies, but in all cases, the size of benefits from this source was expected to be less than the potential benefits from other sources such as improved health, and almost surely less than the cost of the CIRM funding. The largest benefit to the State from CIRM funding is clearly a potential for future healthcare savings.

It is instructive to consider whether there is any evidence of these kinds of economic benefits taking place since CIRM began activities.

A. GRANTS APPROVED AND NEW RESEARCH ACTIVITIES

As expected, CIRM grants have gone to many major universities, research institutes, research hospitals, and university medical schools where we expect them to be used to establish or expand research and possibly related educational activities. Nearly all the major UC universities, other large universities, and major health institutes and organizations have been awarded initial CIRM grants. Figures 3 and 4 summarize the grant amounts to date according to dollar amount and number.

Figure 3: Dollar Amount of Authorized Grants by Institution to Date[36]

Institution	Comprehensive Grants	Disease Team Planning Grants	Major Facilities Grants	New Cell Lines Grants	New Faculty Grants	SEED Grants	Shared Lab Grants	Training Grants	New Faculty II Grants	Grand To
Beckman Research Institute of the City of Hope	-	$55,000	-	-	-	-	-	-	-	$55,000
Buck Institute for Age Research	-	55,000	20,500,000	-	-	734,202	4,140,162	-	-	25,429,3
Burnham Institute for Medical Research	6,071,998	53,150	-	1,589,760	-	5,287,878	3,794,005	1,384,005	-	18,180,7
California Institute of Technology	-	-	-	-	-	-	-	2,071,823	-	2,071,82
Cedars-Sinai Medical Center	-	46,886	-	-	-	-	-	-	-	46,886
Childrens Hospital Los Angeles	2,551,088	-	-	-	-	675,001	2,849,866	2,352,018	-	8,427,97
Children's Hospital Oakland	-	55,000	-	-	-	-	-	-	-	55,000
Children's Hospital of Los Angeles	-	33,110	-	-	-	-	-	-	3,240,000	3,273,11
City of Hope National Medical Center	-	-	-	-	1,623,064	357,978	-	-	-	1,981,04
Human BioMolecular Research Institute	-	-	-	-	-	714,654	-	-	-	714,654
Ludwig Institute for Cancer Research	-	55,000	-	-	-	691,489	-	-	1,726,564	2,473,05
Novocell, Inc.	-	48,950	-	-	-	-	-	-	-	48,950
San Diego Consortium for Regenerative Medicine*	-	-	43,000,000	-	-	-	-	-	-	43,000,0
Scripps Research Institute	-	-	-	-	5,746,750	784,900	1,734,959	1,051,380	-	9,317,98
Stanford University	15,209,557	107,650	43,578,000	5,665,741	10,731,185	7,602,130	4,137,815	3,708,301	3,155,931	93,896,3
The J. David Gladstone Institutes	3,164,000	53,972	-	3,417,120	-	2,359,466	1,700,145	2,397,239	5,695,200	18,787,1
The Salk Institute for Biological Studies	2,879,210	54,798	-	1,737,720	5,302,171	2,282,885	2,336,915	1,443,031	-	16,036,7
University of California, Berkeley	-	-	20,183,500	-	2,246,020	998,408	2,078,597	2,447,970	1,499,994	29,454,4
University of California, Davis	4,761,654	-	20,082,400	-	2,392,397	836,977	2,846,751	2,688,246	2,158,161	35,766,5
University of California, Irvine	7,436,370	91,985	27,156,000	1,369,800	2,108,683	4,051,965	3,924,579	2,093,100	2,994,328	51,226,8
University of California, Los Angeles	5,033,444	97,292	19,854,900	2,560,048	7,579,777	4,179,055	2,862,497	3,695,407	5,453,572	51,315,9
University of California, Merced	-	-	4,359,480	-	1,581,056	363,707	-	-	1,706,255	8,010,49
University of California, Riverside	-	-	-	-	2,120,833	1,139,456	2,795,473	-	-	6,055,76
University of California, San Diego	7,528,380	110,000	-	1,387,800	2,185,369	3,683,286	2,847,502	3,609,621	11,501,370	32,853,3
University of California, San Francisco	17,395,875	110,000	34,862,400	4,065,764	-	4,884,964	3,872,557	3,515,380	13,671,118	82,378,0
University of California, Santa Barbara	-	-	3,205,800	-	-	-	2,263,889	1,218,242	-	6,687,93
University of California, Santa Cruz	-	-	7,191,950	-	4,530,826	999,999	2,718,660	1,132,201	-	16,573,6
University of Southern California	-	92,575	26,972,500	1,387,508	6,228,270	2,701,518	3,570,769	2,703,943	4,810,521	48,467,6
San Diego State University	-	-	-	-	-	-	-	-	1,725,830	1,725,83
Total	72,031,576	1,120,368	270,946,930	23,181,261	54,376,401	45,329,918	50,475,141	37,511,907	59,338,844	614,312,3

[36] Sources and notes to Figure 3:

A. "$45 Million Headed For Stem Cell Research in California", CIRM press release dated 2/16/2007; "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007; "First Stem Cell Research Facilities Grants Approved", CIRM press release dated 6/5/2007; "CIRM Announces New Faculty Awards to Fund Next Generation of Stem Cell Scientists", CIRM press release dated 12/12/2007. Note that the figures were derived by reconciling the data from the above press releases.

B. "$45 Million Headed For Stem Cell Research in California", CIRM press release dated 2/16/2007; "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007; ICOC Meeting Transcript dated 10/3/2007, p. 142-143. These amounts are two-year budget figures requested and approved by CIRM.

C. "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007, and ICOC Meeting Transcript dated 10/3/2007, p. 143. Note that these amounts are four-year budget figures requested and approved by CIRM.

D. "First Stem Cell Research Facilities Grants Approved", CIRM press release dated 6/5/2007. Note that these amounts are three-year budget figures requested and approved by CIRM.

E. "CIRM Announces New Faculty Awards to Fund Next Generation of Stem Cell Scientists", CIRM press release dated 12/12/2007. A potential amount of $30 million in additional New Faculty Awards will be considered at an ICOC meeting in January 2008 (per discussion with CIRM).

F. I. "CIRM Announces New Faculty II Awards to Support Early Careers of Promising Stem Cell Researchers", CIRM press release dated 8/ 13/ 2008.

Figure 4: Number of Authorized Grants by Institution to Date[37]

	Count of									
Institution	Comprehensive Grants	Disease Team Planning Grants	Major Facilities Grants	New Cell Lines Grants	New Faculty Grants	SEED Grants	Shared Lab Grants	Training Grants	New Faculty II Grants	Grand Total
Beckman Research Institute of the City of Hope	-	1	-	-	-	-	-	-	-	1
Buck Institute for Age Research	-	1	1	-	-	1	1	-	-	4
Burnham Institute for Medical	2	1	-	1	-	7	1	1	-	13
California Institute of Technology	-	-	-	-	-	-	-	1	-	1
Cedars-Sinai Medical Center	-	1	-	-	-	-	-	-	-	1
Childrens Hospital Los Angeles	1		-	-	-	1	1	1	-	4
Children's Hospital Oakland	-	1	-	-	-	-	-	-	-	1
Children's Hospital of Los Angeles	-	1	-	-	-	-	-	-	1	2
City of Hope National Medical	-	-	-	-	1	1	-	-	-	2
Human BioMolecular Research	-	-	-	-	-	1	-	-	-	1
Ludwig Institute for Cancer	-	1	-	-	-	1	-	-	1	3
Novocell, Inc.	-	1	-	-	-	-	-	-	-	1
San Diego Consortium for Regenerative Medicine*	-		1	-	-	-	-	-	-	1
Scripps Research Institute	-	-	-	-	2	1	1	1		5
Stanford University	6	2	1	4	4	12	1	1	1	32
The J. David Gladstone Institutes	1	1	-	2	-	3	1	1	2	11
The Salk Institute for Biological	1	1	-	1	2	3	1	1	-	10
University of California, Berkeley	-	-	1	-	1	2	1	1	1	7
University of California, Davis	2	-	1	-	1	2	1	1	1	9
University of California, Irvine	3	2	1	1	1	7	1	1	1	18
University of California, Los	2	2	1	2	3	7	1	1	2	21
University of California, Merced	-	-	1	-	1	1	-	-	1	4
University of California, Riverside	-	-	-	-	1	2	1	-	-	4
University of California, San Diego	3	2	-	1	1	6	1	1	4	19
University of California, San	7	2	1	3	-	9	1	1	5	29
University of California, Santa	-	-	1	-	-	-	1	1	-	3
University of California, Santa Cruz	-	-	1	-	-	2	1	1	-	7
University of Southern California	-	2	1	1	2	4	1	1	2	14
San Diego State University	-	-	-	-	-	-	-	-	1	1
Total	28	22	12	16	20	73	17	16	23	229

We inquired of several recipients about their views about the impacts of CIRM funding. While this information is self-reported, the responses we received back do support the view that CIRM funding is associated with increases in research activities. Several institutes have credited CIRM with enabling their stem cell programs to grow in ways that were not possible prior to the passage of Proposition 71. An example of this is the responses from UC Davis to our inquiries:

[37] Sources and notes to Figure 4:

A. "Stem Cell Institute Awards First Scientific Grants", CIRM press release dated 4/10/2006.
B. "$45 Million Headed For Stem Cell Research in California", CIRM press release dated 2/16/2007; "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007; ICOC Meeting Transcript dated 10/3/2007, p. 142-143.
C. "$75 Million Boost For California Stem Cell Scientists", CIRM press release dated 3/16/2007, and ICOC Meeting Transcript dated 10/3/2007, p. 143.
D. "First Stem Cell Research Facilities Grants Approved", CIRM press release dated 6/5/2007.
E. "CIRM Announces New Faculty Awards to Fund Next Generation of Stem Cell Scientists", CIRM press release dated 12/12/2007. A potential amount of $30 million in additional New Faculty Awards will be considered at an ICOC meeting in January 2008 (per discussion with CIRM).
F. I. "CIRM Announces New Faculty II Awards to Support Early Careers of Promising Stem Cell Researchers", CIRM press release dated 8/ 13/ 2008.

University of California – Davis

Prior to 2004, UC Davis had an active stem cell research program which was almost entirely funded by the NIH and thus not able to study non-federally approved lines. The lack of any "NIH-free" facilities mandated that even had private money been available for research, it could not have been done in the then-existing facilities. Prior to CIRM, the program's annual funding was $2.5 million per year and it supported approximately 35 faculty members.

Since CIRM's passage in 2004, the *Stem Cell Program* at UC Davis has developed significantly, receiving over $11 million dollars in grant approvals from CIRM to date and allowing the program to develop new NIH-free facilities, explore novel cell lines, conduct high risk/high impact studies and train new scientists through a new training program.

Faculty have expanded from 35 to over 100, and they are involved in the multidisciplinary research program that bridges the Schools of Medicine and Veterinary Medicine, the Colleges of Biological Sciences, Engineering and Agricultural and Environmental Sciences.

Finally, plans are in place to bring these researchers together in a new *UC Davis Stem Cell Institute*, which will be a renovated 100,000 square foot building on the Medical Center campus. While UC Davis continues to be supported by NIH funding, the director of the Stem Cell Program at UC Davis attributes the recent growth and future development of this program to the existence and continued support of CIRM.

A second example is the response of The Scripps Research Institute.

The Scripps Research Institute (TSRI)

TSRI responded to our inquiries regarding CIRM by noting that it considers CIRM funding and support as "vital" to the establishment and future of its stem cell program, which did not exist prior to the approval of Proposition 71 in 2004.

Since the approval of CIRM, it has established the *Center for Regenerative Medicine*, which includes a newly renovated 3,000 square foot laboratory and administration space, and has plans to construct a Training center for human embryonic stem cell courses. The interdisciplinary center is working to developing therapies for liver, kidney, heart, and lung diseases; Parkinson's, Huntington's, and Alzheimer's diseases; and blood, bone, skin, and immune systems disorders such as HIV/AIDS.

The center has seven researchers and has plans to add three more in the next few months. The training center has a full time coordinator as well. While the majority of funding for these programs comes from TSRI investment and CIRM, the center also receives funds from the NIH and Alzheimer's Association. Over the next two to three years, TSRI expects that over one hundred stem cell researchers will become *Center* members. Longer term, TSRI expects to position the center as a center of excellence for the larger, global stem cell scientific community.

As another example, CIRM is credited as being the catalyst for four research organizations in San Diego to found the *San Diego Consortium for Regenerative Medicine* to develop an inter-institutional facility to support stem cell research (funded in part by CIRM grant money).

Another way of looking at the potential for expanded research and educational activity is to track changes in the number of personnel performing stem cell related work. There is evidence that there have been increases in California. One report recently claimed that California has outpaced every other state in recruitment of top scientists; with nearly 50 senior stem cell researcher

leaders recruited by California institutions since Proposition 71 passed in 2004.[38] It is difficult to know precisely how many of these new researchers represent net new research activity for California, though some preliminary evidence suggests that there is noticeable net new activity. As an example, of the established senior researcher leaders recruited by California institutions cited in the above-referenced report, 45 appear to have come from out-of-state. According to CIRM records, eight of the scientists that came from other states are directly funded by CIRM – with grants ranging from approximately $340,000 to over $3,000,000.[39]

Since the passage of CIRM, researchers have clearly been attracted to California from abroad, including notable scientists from Australia, Canada, Germany, Israel, Japan, New Zealand, and the United Kingdom. Of particular note is the recruitment of Dr. Shinya Yamanaka from Kyoto University and Dr. James Thompson from University of Wisconsin. It is perhaps not surprising that CIRM would be associated with the attraction of new scientists to California, as only half a dozen states other than California actively support stem cell research and CIRM has helped to create a stable long-term environment for stem cell research in California.

B. LEVERAGE

The use of CIRM funds in ways that could attract other donations to support stem cell research is another possible source of benefits, again if these other donations represent net new activity to California. CIRM's expectation was that CIRM grants would be augmented by a minimum of 20 percent matching funds that recipients would have to obtain from other sources. Initial averages obtained from CIRM following the approval of the Shared Lab and Course Training grants and the Major Facilities Grant Program indicate that this was a conservative estimate. In the tables to this report, we have provided updated information on donor and institutional matching funds, which have greatly exceeded the minimums set by CIRM and the initial estimates used in the economic analyses of Proposition 71.

In addition to the grant-mandated matching funds leverage, several universities have made available additional facilities renovations and establishment of stem cell research institutes which have generated additional economic benefit, such as an estimated $19 million from Stanford in renovations of leased facilities to be used for stem cell research. While it is likely that some amount of this additional funding would have occurred regardless of the outcome of the Proposition 71 legislation, it highlights the potential for additional economic benefit by leveraging additional sources of funds. Further research would be required to determine how much of the "leverage" spending represents net new economic activity for California and how much would have taken place without CIRM, such as philanthropy that would otherwise have been redirected within California at objectives other than stem cell research within California.

Another form of leverage is the provision of free or subsidized office space to CIRM, such as the estimated $18 million worth of office space, hotel rooms, and conference facilities to support CIRM headquarters and related activities.[40] As above, it is not immediately clear how much of this is represents net additional activity, but the presence of this kind of investment from additional sources is consistent with the view that it is possible for CIRM activities to have positive economic benefits.

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[38] "California Takes Lead in Stem Cell Research, Scientist Recruitment," Michaels, Spencer, PBS transcript, aired 10/8/2007. http://www.pbs.org/newshour/bb/health/july-dec07/stemcell_10-8.html. The full report also lists scientists that were recruited from California institutions, which would not be considered incremental benefit to California and are not included here.

[39] "Migration of Stem Cell Researchers to California, Since January 2005," CIRM.

[40] "California Institute for Regenerative Medicine, Annual Report 2006," page 7.

C. NEW BUSINESS ACTIVITY

If the improved environment fostered by CIRM were to attract new businesses to the State, or encourage existing businesses to expand, this could be a source of new economic activity. There are reports suggesting that this has occurred, although a comprehensive analysis of this would require additional effort. As an example, Jackson Labs has expanded facilities, Stem Cell Sciences is expanding into California from the UK, and companies like Invitrogen and Novocell (formerly CyThera) have hired new scientists from within and outside the U.S.[41]

In a related way, though perhaps on a smaller scale, the creation of CIRM itself results in an institution that generates economic activity through salaries, benefits, and expenses. CIRM has over 25 employees with fiscal year ended, June 2007 salaries and had operating expenses since inception as listed in Figure 5 below. For example, CIRM has recently named Alan O. Trounson, Ph.D. from Monsash University in Australia, as the new President[42] Arlene Chiu, who relocated to California, was the first head of Scientific Activities.[43]

Figure 5: Summary of CIRM Expenses Incurred To Date[44]

	From Inception to June 30, 200	June 20, 2006	June 30, 2007	June 20, 2008 (Unaudited)
Salaries & Wages	$736,705	$2,647,479	$3,505,137	$4,334,938
Operating Expenses & Expenditures	$1,833,113	$2,932,383	$3,451,524	$3,291,582
Total	**$2,569,818**	**$5,579,862**	**$6,956,661**	**$7,626,520**
Net Cost to State				**$22,732,861**

D. PHILANTHROPY

In addition to the CIRM grants for stem cell research which are funded by the bond initiative, there has been a substantial amount of other philanthropic activity and funding for stem cell research in California since January 2005.[45] In total, well over $900 million dollars has been donated by various organizations and individuals to California universities and institutes to fund direct research, construction, and improvement of facilities, and recruitment related to stem cells.[46] This is a substantial amount compared to the amount of total CIRM commitments to date. Many of these grants are substantial and have been used to found stem cell institutes within universities, including many of those mentioned in this report. For example, in 2006 University of California, San Francisco raised over $16 million from Ray and Dagmar Dolby to develop its *Institute for Regeneration Medicine,* including hiring over five

[41] "Migration of Stem Cell Researchers to California, Since January 2005", CIRM. Novocell is headquartered in San Diego, CA and merged with CyThera and Bresagen in 2004, http://www.novocell.com/about/ as accessed on 12/29/07.

[42] "Renowned Scientist to Lead California Stem Cell Institute", CIRM press release dated 9/14/2007.

[43] "Chief Scientist Joins Stem Cell Institute Leadership Transition Team and Announces Future Role', CIRM press release dated 8/24/2007. Dr. Chiu was originally Director of Scientific Activities and recently stepped down, she is currently serving as a consultant to CIRM through June 2008.

[44] Sources and notes to Figure 5:

A. "California Institute for Regenerative Medicine, Annual Report 2006", page 75.
B. "California Institute for Regenerative Medicine, Independent Auditor's Report", Financial Statements and Required Supplementary Information For the Year Ended June 30, 2006, page 20.
C. Unaudited Budget CIRM data for the year ended June 30, 2007.
D. Operating Expenses include legal fees which may not continue occurring in the future (per information from CIRM).
E. Per information from CIRM.
F. CIRM costs are funded through bond proceeds, not State operating budget funds.

[45] "Reported Stem Cell Activities in California: 2005-2007," CIRM, November 2007.

[46] See Figure 12 in Addendum 1 to this Report.

preeminent stem cell scientists.[47] Stanford University received $33 million from Lorey I. Lokey in early 2007 for the *Stanford Stem Cell Labs*.[48] Both UCLA and USC were also given donations for their stem cell institutes with $25 million each from Eli Broad, a private donor.[49]

A notable example of philanthropic giving is the recent expansion of stem cell research programs and facilities at University of California, Berkeley. Historically, prior to fall 2004, the stem cell research at UC Berkeley consisted of research programs of four faculty members whose laboratories were spread over three separate buildings and the university had not undertaken any stem cell research fundraising efforts. Following the founding of CIRM, UC Berkeley received philanthropic donations from individuals and foundations totaling over $10.5 million and used the funding, in part, to recruit 24 additional faculty members (5 principal investigators and 19 faculty members for part-time stem cell research projects) and consolidate laboratories into one building. Now, in January 2008, the university plans to begin construction of a 200,000-square foot building (the Li Ka-Shing building) one half of which will be dedicated to stem cell research. The projected construction cost for the Li Ka-Shing building is $200 million and the university has already received commitments from private philanthropic sources for $93 million. UC Berkeley plans to finance the remainder of the construction with funds from the State of California and from individuals and foundations, including CIRM. As a recipient of multiple CIRM grants, the university recognizes CIRM's role in "increasing awareness and interest in stem cell research among students and the donor community."[50]

Figure 6: Selected Stem Cell Major Philanthropic Gifts 2005-2007[51]

Donor	Recipient	Amount
Lorey Lokey	Stanford University	$33,000,000
The Broad Foundation	University of Southern California	$25,000,000
Eli Broad	Univer of California, Los Angeles	$25,000,000
City of San Francisco	CIRM	$18,000,000
Ray and Dagmar Dolby	University of California, San Francisco	$16,000,000
Bill and Sue Gross	University of California, Irvine	$10,000,000
Ray and Dagmar Dolby	CIRM	$5,000,000

This is not a comprehensive listing of all philanthropic gifts for stem cell research in California. In the case of the Eli and Edythe Broad Foundation gift to UCLA, Eli Broad is quoted as stating, "California is at the vanguard of stem cell research, and we need to leverage the voter-approved funds of Proposition 71."[52] Certainly a stable legal situation and a strong source of research funding will generally encourage philanthropic gifts that otherwise might not have occurred. The institutions receiving these funds for stem cell research have specifically cited them in their applications for major facilities grants as new funds obtained to meet the matching funds and leverage requirements in the major facilities competition for CIRM funding.

E. SUMMARY

The information available to date suggests that there is potential for economic benefits in the form of expanded research and business activity associated with CIRM activities, and even that California may already be starting to see some benefits. More

[47] "Reported Stem Cell Activities in California: 2005-2007,"CIRM, November 2007.

[48] "Reported Stem Cell Activities in California: 2005-2007,"CIRM, November 2007.

[49] "Reported Stem Cell Activities in California: 2005-2007," CIRM, November 2007.

[50] Information provided directly by University of California, Berkeley in response to our requests.

[51] "Reported Stem Cell Activities in California: 2005-2007," CIRM, November 2007.

[52] "The Broad Foundation Donates $20 million to UCLA Stem Cell Institute," UCLA Newsroom, September 10, 2007.

careful analysis that could better assess the extent to which these are incremental increases in activity for California would provide valuable information. For example, a systematic survey of the universities to understand the role CIRM is playing in fund-raising and University planning could provide data for future analysis. Similarly, a survey of stem cell related private ventures could help assess the extent to which CIRM is having positive effects on overall economic activity in California. Further analysis could also more precisely consider the potential for benefits of different types, such as benefits for the State finances.

2. BENEFITS FROM HEALTH PROMOTION

By far, the most important future area of benefit that has received significant attention is the extent to which new stem cell research could produce benefits for California in the form of improvements in health. Over 50 percent of the total financial benefits to the state were originally projected to come from future health care cost reductions in California. The mechanism through which this might occur is the development of new therapies faster than would otherwise have been the case without CIRM funding. If CIRM is ultimately successful in helping develop new therapies, economic benefits could come in many forms, from those easily quantifiable to those that would be more difficult to quantify.

Accelerating the availability of new therapies that extend or improve the quality of life would clearly produce benefits for individuals suffering from conditions to which the new therapies could be applied. The value of improvements in health themselves may be difficult to quantify economically, though there are methods that can support comparative activities and efforts to relate benefits of new therapies to their costs are frequently attempted. For example, economists and others often undertake cost-effectiveness analyses using quality-adjusted life years as a measure of benefit of a program.[53]

Other economic effects of accelerating the availability of new therapies may be easier to quantify. New therapies could change the amount of resources that society must devote to caring for the sick, which could result in savings if the cost of new therapies is lower than the costs of any other treatments that are rendered unneeded in the presence of a new stem cell discovery, or could result in higher costs if the costs of the new therapy are larger than any cost reductions that might result elsewhere. Accelerating the availability of new therapies that produce improvement in health could also produce benefits in other ways, such as through improved productivity by workers whose health is improved, or reductions in the burdens imposed by sick individuals on family members and other caregivers.

The magnitude of any such benefits that might be realized cannot be known with certainty at this point, but some general lessons seem clear based on previous research. First, if there were to be new substantial acceleration in the availability of discoveries that led to useful new therapies, the benefits could be quite large. The most important source of benefits would be improvements in the quality or length of life. On the financial side, our original report on the potential economic effects of Proposition 71 considered some hypothetical scenarios about impacts on the State finances from small changes in spending on a number of specific health conditions. Other subsequent work has used other modeling approaches that can illustrate the effects of hypothetical changes in the time at which new beneficial therapies become available. The clear conclusion is that even moderately successful new therapies would have the potential to produce large benefits for society in the form of improved health. Other economic benefits that could flow from better health are also potentially significant, particularly if a new stem cell based therapy were to provide relatively inexpensive substitutes for currently costly treatments and thus help lower health care spending. Of course, these analyses also make clear that the net changes in health care spending will depend upon the costs of delivering a new stem cell based therapy. If costs of new therapies are high and cost savings are not substantial, spending may not go down, though there might still be better

[53] "Cost-Effectiveness in Health and Medicine," Gold, Marthe R., Siegel, Joanna E., Russell, Louise B., and Weinstein, Milton C., 1996.; "Willingness to Pay for a Quality-adjusted Life Year: In Search of a Standard," Hirth et al., Medical Decision Making, Vol. 20, No. 3, 332-342 (2000).

health outcomes for patients. Financial benefits come from the basic therapeutic model for stem cell therapies, which assumes a therapy integration that mitigates or cures the chronic disease or injury, resulting in a long-term stream of avoided costs.

CIRM research grants are just beginning to go out, and it would not be reasonable to expect any health benefits or therapies attributable to CIRM at this time. Making predictions about the likelihood of particular future breakthroughs for particular diseases is outside our area of expertise. It is possible that no new treatments of widespread therapeutic use will be developed, which would mean very limited or no economic benefits from improved health. At the same time, we observe that therapy development is still considered quite promising by many. We are not aware of any new information that would seem to suggest that realizing benefits from stem cell research has become less probable over time. In fact, if anything, the research and funding community seems even more optimistic about the potential for stem cells than they did just 2 or 3 years ago. Several market research reports forecast substantial growth in stem cell based therapies over the next decade or so.[54] In addition, a number of private sector companies are pursuing, with some apparent successes, continuing research into stem cell technologies.[55] It is also clear that there remain many therapeutic areas in which stem cell research is viewed as promising. For example, a recent Frost and Sullivan report of the industry notes the following potentially important areas for stem cell research, all of which are serious conditions that afflict large populations and result in high costs:[56]

- Diabetes (including juvenile diabetes),
- Cancer (primarily to combat the toxic effects of chemotherapy or for targeting only cancerous cells),
- Cardiovascular disease (myocardial infarction, coronary artery disease),
- Neurological disorders (including Alzheimer's, multiple sclerosis, Parkinson's, and stroke),
- Cartilage and bone degeneration (including grafting and stem cell tissue regeneration),
- Blood disorders (stem cells derived from bone marrow have been treating blood related disorders for leukemia, lymphoma, and others for decades), and
- Spinal cord – pending human clinical trials

Were there to be new discoveries that produce health benefits, one complicating issue that will require attention for purposes of CIRM is the attribution of new discoveries to their underlying funding sources. Science is an inherently incremental activity. Discoveries made by researchers receiving CIRM funding will almost certainly have roots in research done and funded by others. Research on stem cell therapies in other countries may aid those who work with CIRM funds. Similarly, breakthroughs in the future may well have contributions from CIRM funds even if the actual breakthrough does not occur on a CIRM-funded project. We suggest that CIRM incorporate as part of its grant follow-up process a short set of questions to recipients identifying others who

[54] Several market research reports have estimated that the sales of treatments and therapies associated with stem cells is approximately $30 million, and forecasted to grow to $700 million by 2010 and $8.5 billion by 2016. Source: "Stem Cell Industry Set to Break Out," Cox, Jeff, 6/7/2007, CNNMoney.com (accessed 11/15/2007).

[55] As an example, Orisis Therapeutics is on the verge of FDA approval for a stem cell derived treatment for Graft v. Host Disease. Other key stem cell companies with therapies in various stages of development and pre-clinical trials include Advanced Cell Technologies, Aastrom Biosciences, Cytori Therapeutics, Geron, StemCells and ViaCell. Source: "Playing Stem Cell Lottery"," Seiler, Geoffrey, 3/15/2006, Forbes.com, "Cytori Looks for Fat Profits," The Street.com, 6/26/2007; and "Advanced Cell Technology in search of corporate stem cell partners," Los Angeles Business, 12/07/2007.

[56] "Developments in Stem Cell Research," Frost & Sullivan, 2007.

may have benefited from any breakthroughs associated with the funding. This should not be done with any specific tax revenue implications in mind, but rather to ensure that contributions from foundational research is not overlooked in the ultimate evaluation, even if the actual therapies are not funded by CIRM grants.

3. BENEFITS FROM INTELLECTUAL PROPERTY

One of the more controversial areas of CIRM's economic impact has been the extent to which the State of California will benefit from royalties associated with CIRM-funded research, originally projected to be equal to only 8 percent of the total benefit**.** As noted in earlier studies, the State certainly has a model of benefiting from royalties on discoveries through the University of California's patent portfolio.

Ultimately the amount of revenue realized from royalties will depend upon a combination of what scientific breakthroughs are developed with CIRM funds, the potential intellectual property rights associated with these breakthroughs and the public policy choices made by elected and appointed officials.

It is too early to see how these economic benefits will develop. Even in the most optimistic scenarios, CIRM funding is not likely to produce potentially revenue-generating intellectual property for several years. The original analysis submitted to California's Legislative Analyst illustrated the first intellectual property receipts collected in year 14, with the vast majority of intellectual property receipts not occurring until years 15-35. We believe it is possible that the economic impact could be significant, however, we also believe this is an area where the political choices have been evolving, and we would anticipate that future benefits could be different from those first estimated. As discussed earlier, CIRM has been active in this area, and there may be additional changes in the future. We recommend that tracking intellectual property continues to be a factor in making and monitoring CIRM grants.

5. Conclusion

Because of the legal challenges, it has taken CIRM longer to begin its primary funding activities than was originally anticipated at the time of the passage of Proposition 71 in November, 2004. Despite the delay, CIRM has been quite active in soliciting, approving, and beginning to fund grants. The next few years will see a substantial increase in the funds being disbursed by CIRM as part of these grants, many of which are multi-year.

This early analysis of CIRM's activities to date is consistent with the view that there is an important potential for economic benefits to California. CIRM funding is viewed as an important contributor to expanded research activities. California have been successful at providing leverage funds and raising substantial additional funds from private sources for stem cell activities. California has attracted top stem cell scientists from around the United States and indeed around the world. Outside analysts and commentators continue to be optimistic about the potential for stem cell research to generate major new health benefits to the world. While this does not prove that CIRM funding is creating net increments in benefits for Californians, the existence of these kinds of effects is a necessary component of any benefits, and thus their existence is a promising sign.

We have provided several recommendations for monitoring the economic impact of CIRM going forward. By tracking economic impact from the beginning, it will ultimately be easier and more accurate for future analysis of the ultimate analysis of this unique endeavor.

6. Appendix A: Previous Economic Impact Studies and CIRM Background

Both the authors of this report were involved in the evaluation of the potential economic impact of the California Stem Cell Initiative, then known as Proposition 71. The evaluation consisted of two reports. The first report, *Analysis of the Financial Impact on the California State Budget of the Proposed California Institute of Regenerative Medicine*, was released over four years ago, October 27, 2003. This report focused on the anticipated interest expense, debt service, and tax revenue associated with the bond issuance, servicing, and payback during the first few years of CIRM's existence. Specific assumptions and estimates from this study included:

- $974 million in anticipated funding provided during years 1-5, $282 million of which would be facilities funding and $674 million in research and administration funding.

- $56 million in interest expense in the first five years if the interest rate were 3.0 percent. The Legislative Analyst used a 5.25 percent interest rate in their analysis.[57] Despite recent turmoil in the credit market, the actual rates are still below the Legislative Analyst's estimate.[58]

- Incremental tax revenues generated from net spending of approximately $70 million, or 1.25 times the incremental interest cost in years 1-5.

The second report, released September 14, 2004 (approximately three years ago), was entitled the *Economic Impact Analysis: Proposition 71 California Stem Cell Research and Cures Initiative.* This report focused on a broader set of potential economic impacts of CIRM over a longer time period, with analysis of not only the first five years (then estimated to be 2005-2009), but through the 2039 estimated life of the bond repayments. Estimates included (all in future dollars):

- Total costs of approximately $5.4 billion, including the original principal payout of $3 billion and interest on the bonds being paid until their final redemption 35 years later.

- 5,000 – 22,000 new job years created per year

- $240 million in incremental income and sales tax revenue

- $2.2 – 4.4 billion in incremental income and sales tax revenue through increased private sector investment in California's biotechnology industry (estimated potential increases of 2.5 – 5.0 percent increase.

- $3.4 – 6.9 billion in savings to State government spending on health care associated with potential reductions of 1-2 percent per year for major conditions, including stroke, heart disease (acute myocardial infarction), insulin dependent diabetes, Parkinson's disease, spinal cord injury, and Alzheimer's disease.

- $9.2 billion – $18.4 billion in potential benefit to all Californians from spending in health care associated with possible reductions of 1-2 percent per year for the six major conditions listed previously.

[57] Proposition 71: Analysis by the Legislative Analyst

[58] "Treasurer Lockyer Announces Results of First Stem Cell Research Bond Sale; Individuals Buy $102.8 Million of $250 Million", CIRM Press Release dated 10/4/2007; information from CIRM

- $537 million – $1.1 billion in potential revenues from royalties to the State associated with CIRM-funded research.

- It is important to note that of the nearly $6.4 billion in total cost savings to the State Budget, the taxes and intellectual property royalties were a small portion. Tax revenues from direct spending and from induced growth in the biotechnology industry accounted for 4 percent and 34 percent of the total benefits to the State finances, respectively. Likewise, possible royalties' benefits, which were estimated to begin in year 14, with the vast majority of benefit in years 15-35, amount to only 8 percent of the total estimated State finances savings. The greatest potential economic benefit comes from the health care cost savings of $3.4 billion (State finances benefit) and $9.2 billion (additional benefits to California not included in State finances). The base case scenario for this benefit assumes a 1 percent net health care cost savings from six identified conditions. Note that this assumption did not rely on cures, but rather the very small 1 percent of net cost savings. Please see Figure 7 below for details:

Figure 7: Possible Economic Benefits to State Finances and California as Projected in the Original Proposition 71 Study

	Phase 1 Years 1-5	Phase 2 Years 6-14	Phase 3 Years 15-35	Total	Total Accounting for Time Value of Money
Economic Costs to State Budget	$56	$1,289	$4,010	$5,355	$2,071
Economic Benefits to State Budget					
1) Tax revenues from Proposition 71 direct spending	73	167	-	240	174
2) Tax revenues from 2.5% increase in life sciences activity	54	355	1,796	2,206	774
3) Cost savings from 1% reduction in State spending on 6 conditions	-	382	3,062	3,444	1,092
4) Royalty revenues using 2% royalty rate	-	10	527	537	189
Total	**127**	**914**	**5,385**	**6,426**	**2,229**
Percent of Total Costs	***227%***	***71%***	***134%***	***120%***	***108%***
Additional Benefits to Californians Not Included in State Budget*					
Health care cost savings from 1% cost reductions	**-**	**1,136**	**8,043**	**9,180**	2,932
Percent of Total Costs	*0%*	*88%*	*201%*	*171%*	*142%*
Estimated Jobs Created (One job for one year = one job year)					
Job years from Proposition 71 direct spending	14,272	33,209		47,480	
Job years from Increase in life sciences activity	11,967	67,732	233,148	312,847	
Total	26,239	100,940	233,148	360,328	

** These are savings from the reduction in direct spending and lost work time on the 6 disease conditions for Californian's private health care costs beyond those included in the State finances but that benefit Californians overall.*

One can analyze both costs and benefits in either actual dollars as they will be spent in the future or the present value of the spending discounted to current dollars. We understand that the State of California requires any ballot measure to capture future value and cost. As in our original analysis, we note both the future value and the discounted, present value basis ("Total Accounting for the Time Value of Money") as shown in the figure above.[59]

The $6.4 billion in total cost savings to the State finances over the 35 years would amount to $2.2 billion in total benefits on a present value basis (see Figures 8 and 10 below).[60] Likewise, the total cost of the initiative of $5.4 billion would amount to $2.1 billion on a

[59] In our original report addendum, dated October 26, 2004, we had used a discount rate of 6.0%, however, based on the most recent information and the report of the Legislative Analyst (source: Proposition 71: Analysis by the Legislative Analyst) we have based the discounting exercise here on a discount rate of approximately 5.25%.

[60] Our present value analysis is as of the date that the previous report, or late 2004. We have not updated the original analysis to 2007 dollars for the purposes of this exercise.

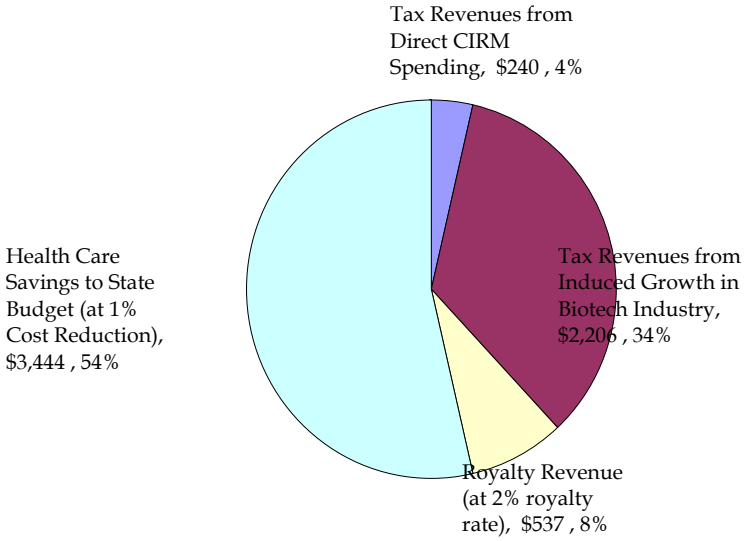
present value basis (see Figure 7). In this manner it is possible to more closely capture the differences between the costs and benefits of the initiative. Of course, the precise present values would vary depending on the discount rate used.

In addition to the direct cost savings to the State, we also estimated the additional cost savings that could be attributed to Californians as a whole. The cost savings would be independent of the State finances and would come from general health savings derived from stem cell therapies of the six identified diseases. While the projected cost savings was a modest one percent, the estimated benefits of our original analysis over the 35 years were $9.2 billion in undiscounted future dollars. That savings translates into a present value of additional health care savings to Californians of $2.9 billion (see Figures 9 and 11 below).

Our original report estimated that these two categories together – potential savings to the State and potential health care savings to Californians as a whole – were over $15.6 billion in undiscounted future dollars and $5.2 billion in present value (see Figures 9 and 11 below). As discussed above, benefits to the State finances were modeled from several sources, shown below in both undiscounted, future value amounts and discounted, present value amounts:

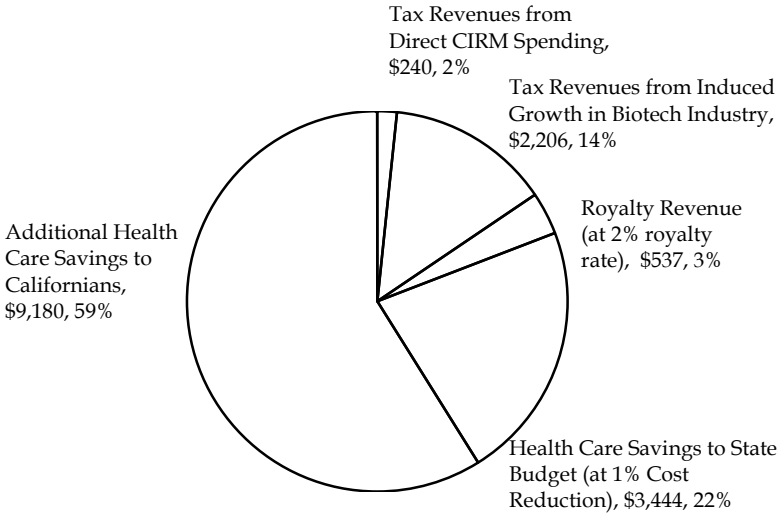
Since the original reports produced during the Proposition 71 campaign, there have been several other studies and reports of which we are aware. These are listed as Appendix C.

Figure 8: Original Propositions 71 Economic Projections as of Sept. 2004
Benefits to State Finances During Years 1-35
$Millions (Future Value)



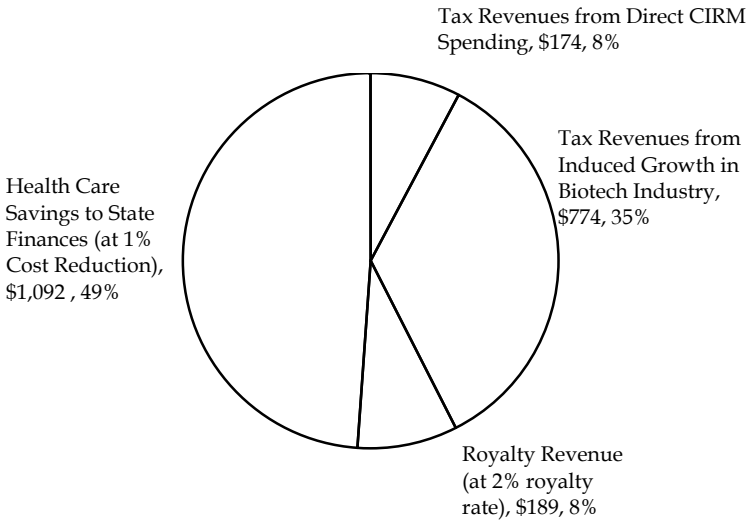
Total = $6.4 Billion

Figure 9: Original Propositions 71 Economic Projections as of Sept. 2004
Additional Benefits to Californians During Years 1-35
$Millions (Future Value)



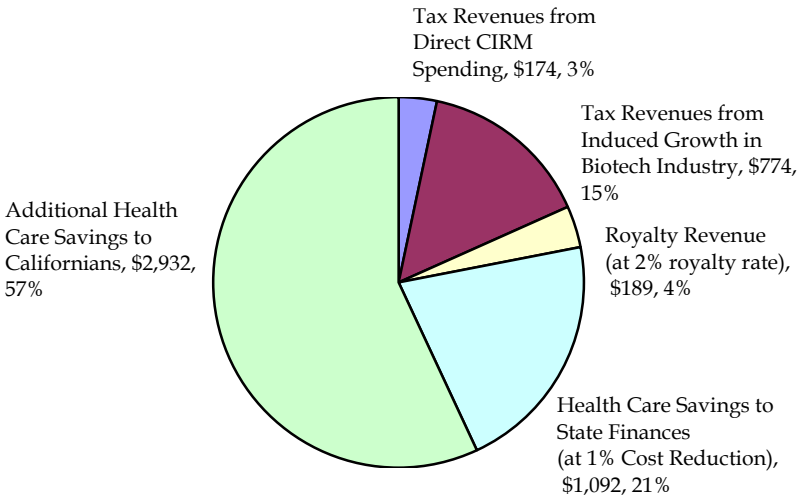
Total = $15.6 Billion

Figure 10: Original Propositions 71 Economic Projections as of Sept. 2004
Benefits to State Finances During Years 1-35
$Millions (Present Value)



Total = $2.2 Billion

Figure 11: Original Propositions 71 Economic Projections as of Sept. 2004
Additional Benefits to Californians During Years 1-35
$Millions (Present Value)



Total = $5.2 Billion

Source: Baker, Laurence and Deal, Bruce, Economic Impact Analysis: Proposition 71 California Stem Cell Research and Cures Initiative, September 14, 2004, Addendum October 26, 2004

7. Appendix B: Project Team and Qualifications

Professor Laurence Baker, Stanford University

Chief of Health Services Research; Professor of Health Research and Policy, School of Medicine, Stanford University.

Professor Baker is a health economist with extensive experience in a wide range of health economics and health policy areas. He has many years of experience in analyzing relationships between area characteristics and the performance of the health care system, including published studies on the effects of managed care and insurance market competition on Medicare spending, treatment patterns and quality of care for Medicare patients, and the adoption of medical technologies. His work has been published in JAMA, New England Journal of Medicine, American Economic Review, and the Journal of Health Economics, among others. In 1999, he received Academy Health's Alice Hersch Award for the best young investigator. Professor Baker's studies of the relationships between area characteristics and health care delivery have twice won the National Institute for Health Care Management's best research prize. Dr. Baker holds a Ph.D. in Economics from Princeton and a B.A. in Economics from Calvin College.

Bruce Deal, Managing Principal, Analysis Group, Menlo Park, CA Office

Mr. Deal is Director of the firm's Insurance practice and heads the economic analysis in the Menlo Park, California office. He has two decades of experience in economic, litigation, and management consulting, and has managed dozens of assignments requiring complex economic analysis of publicly available and internal client information. Mr. Deal has served as an expert witness in various litigation and non-litigation matters. Mr. Deal's industry experience has included insurance, technology, telecommunications, healthcare, and others. He co-authored a study, *Economic Impact Analysis: Proposition 71 California Stem Cell Research and Cures Initiative* with Laurence Baker, an Analysis Group academic affiliate and Stanford University School of Medicine faculty member. Prior to joining Analysis Group, Mr. Deal spent several years as a consultant and manager with Arthur Andersen providing financial and economic consulting services to healthcare clients. Mr. Deal holds a Master in Public Policy degree from Harvard University and a B.A. in Economics from Pacific Lutheran University.

Sara Filipek, Manager, Analysis Group, San Francisco, CA Office

Ms. Filipek has expertise in economics, finance, and strategy engagements covering litigation, strategic business and policy contexts. Her experience spans the healthcare, insurance, biotechnology, financial services, telecommunications, and information technology industries. Ms. Filipek has conducted research and analysis in International Trade Commission cases involving domestic industry and remedy issues, consulted pharmaceutical companies on health outcomes and coverage and reimbursement strategies for product development and commercialization objectives, and managed public policy studies including cost benefit studies for stem cell initiatives in California and Missouri. Prior to joining Analysis Group, Ms. Filipek was an Associate at IFC/World Bank and Senior Analyst at Broadview (Jefferies). She holds an M.B.A from the University of California, Berkeley and an A. B. in Economics from Smith College.

8. Appendix C: Bibliography and Sources

Report Sources

"$45 Million Headed For Stem Cell Research in California," CIRM press release dated 2/16/2007

"$75 Million Boost For California Stem Cell Scientists," CIRM press release dated 3/16/2007

"Advance in Stem cell Work Avoids Destroying Embryos," Naik, Gautam, 11/21/2007, The Wall Street Journal

"Advanced Cell Technology in search of corporate stem cell partners," Los Angeles Business, 12/07/2007

"Bay Area Professor Aids in Stem Cell Breakthrough," Johnson, Steve, 11/20/2007, The Mercury News.

"California Stem Cell Project Prevails," CIRM Press Release dated 2/27/2007

"California Takes Lead in Stem Cell Research, Scientist Recruitment," Michaels, Spencer, PBS transcript, aired October 8, 2008. http://www.pbs.or/newshour/bb/health/july-dec07/stemcell_10-8.htm

"CIRM Solicits Major Facilities Grant Applications," CIRM press release dated 8/24/2007

"Cost-Effectiveness in Health and Medicine," Gold, Marthe R., Siegel, Joanna E., Russell, Louise B., and Weinstein, Milton C., 1996

"Cytori Looks for Fat Profits," The Street.com, 6/26/2007

"Developments in Stem Cell Research," Frost & Sullivan, 2007

"First Stem Cell Research Facilities Grants Approved," CIRM press release dated 6/5/2007

"Litigation Against California Stem Cell Project Ends," CIRM Press Release dated 5/16/2007

"Playing Stem Cell Lottery," Seiler, Geoffrey, 3/15/2006, Forbes.com (accessed 11/15/2007)

"Researchers Report Stem Cell Breakthrough," Weiss, Rick, 11/20/2007, The Washington Post.

"Stem Cell Board Approves Two New Research Initiatives," CIRM press release dated 10/3/2007

"Stem Cell Board Calls State Legislation 'Premature'," CIRM press release dated 4/11/2007

"Stem Cell Industry Set to Break Out," Cox, Jeff, 6/7/2007, CNNMoney.com (accessed on 11/15/2007)

"Stem Cell Institute Awards First Scientific Grants," CIRM Press Release dated 4/10/2006

"Stem Cell Institute Solicits New Faculty Award Proposals," CIRM press release dated 6/28/2007

"Treasurer Lockyer Announces Results of First Stem Cell Research Bond Sale; Individuals Buy $102.8 Million of $250 Million," CIRM Press Release dated 10/4/2007

"Willingness to Pay for a Quality-adjusted Life Year: In Search of a Standard," Hirth et al., Medical Decision Making, Vol. 20, No. 3, 332-342 (2000)

California Institute for Regenerative Medicine, Annual Report 2006

Committed Funds Data, source: CIRM

Matching Fund Data from Shared Research Laboratory Grant Applications, source: CIRM

Migration of Stem Cell Researchers to California, Since January 2005, source: CIRM

Proposed ICOC Biotech Loan Program Task Force, Agenda Item #11B - Updated, 10/3/2007 ICOC Meeting

Reports on Stem Cell Economic Impact

"A Scientific, Policy and Economic Analysis: New York and Stem Cell Research," Barba, James J., et al., January 2006

"Analysis of the Financial Impact on the California State Budget of the Proposed California Institute of Regenerative Medicine," Baker, Laurence and Deal, Bruce, October 27, 2003

"Economic Impact Analysis: Proposition 71 California Stem Cell Research and Cures Initiative," Baker, Laurence, and Deal, Bruce, September 14, 2004

"Proposition 71 and the Creation of a California Institute for Regenerative Medicine: Assessing the Return on this Investment,", Longaker, Michael T., Baker, Laurence C., and Greely, Henry T., Nature Biotechnology, 25: 513-21, May 1, 2007

"The Economic Benefits of the New Jersey Stem Cell Research Initiative," Seneca, Joseph J., Irving, Will, Edward J. Bloustein School of Planning and Public Policy Rutgers, The State University of New Jersey, September 2005

"The Economic Development Potential of Stem Cell Research in Texas," Weinstein, Bernard L., Clower, Terry L., March 2007

"The Missouri Stem Cell Research and Cures Initiative: An Economic and Health Care Analysis", Haslag, Joseph H., and Long, Brian K., August 2006